

4.1.4. SURFACE OZONE

Observations of surface ozone were continued at each of the four baseline observatories, Barrow Observatory (BRW), MLO, Samoa Observatory (SMO), and SPO, as well as at Niwot Ridge, Colorado; Westman Islands, Iceland; and Arrival Heights, Antarctica. In June 2000 a TEI Model 49C ozone analyzer was installed at Summit Station, Greenland. Data from BRW, MLO, SMO, and SPO have been processed through 2001. The monthly mean data for the four sites are given in Table 4.4 for 2000 and 2001. Revised data for 1998 and 1999 for BRW and data for 1999 at MLO are also included. For MLO the average is based on downslope (1000-1800 UTC) data. The data system at SMO experienced a number of outages after the measurements were restarted in 1997 after about a 15-mo gap that included all of 1996 and the first 3 months of 1997. Most of the data for 1997 and 1998 have, however, been recovered from a backup paper chart record.

Trends have been computed for each of the long-term data sets (Figure 4.4), by the methods described in *Harris et al.* [2001], modified to remove effects of the seasonal cycle,

surface temperature, and autocorrelation before the trend is fitted. As an example, Figure 4.5 shows the monthly surface ozone data and the model fit for MLO.

The numerical trends are summarized in Table 4.5. The standard errors are determined by a Monte Carlo technique. At BRW surface ozone amounts were generally increasing in the 1980s and early 1990s but have declined somewhat in recent years. At MLO there has been an overall increase, but after relatively higher ozone amounts in the late 1990s, the past 2 years have had lower values. At SMO ozone mixing ratios have remained relatively unchanged. The significant decline at SPO through the 1980s and early 1990s has nearly recovered in recent years with little overall change now evident. A recent study [*Crawford et al.*, 2001] shows that at SPO during the summer there is vigorous photochemical production of ozone involving the release of nitrogen oxides from the deposit of nitrogen-bearing compounds on the snow surface. This quite likely has minimal impact on the overall tropospheric ozone burden at SPO (or over Antarctica) but does play a role in the reduction of the amplitude of the surface ozone seasonal cycle.

TABLE 4.4. Monthly Mean Surface Ozone Mixing Ratios (ppbv)

YEAR	JAN.	FEB.	MARCH	APRIL	MAY	JUNE	JULY	AUG.	SEPT.	OCT.	NOV.	DEC.
<i>BARROW</i>												
1998*	33.3	29.2	23.5	26.7	22.6	16.3	24.4	21.7	24.9	30.0	33.4	30.7
1999*	29.5	28.3	13.0	9.4	23.3	22.4	18.7	19.2	22.3	31.1	29.9	30.6
2000	27.4	27.2	19.3	10.0	11.3	24.4	17.9	19.1	23.6	30.9	35.2	30.8
2001	30.0	31.3	—	17.3	16.9	23.3	20.4	21.4	25.4	34.9	34.8	33.7
<i>MAUNA LOA (1000-1800 UTC)</i>												
1999	43.1	48.5	48.4	54.9	44.1	41.6	48.3	35.9	46.2	39.4	38.5	36.0
2000	40.8	43.1	46.9	53.8	41.0	45.5	36.2	37.2	—	33.1	33.6	41.3
2001	39.8	40.1	49.4	51.6	46.7	37.2	34.9	39.0	33.8	48.3	37.0	41.7
<i>SOUTH POLE</i>												
2000	26.5	19.8	19.8	24.3	28.7	31.4	32.3	31.8	32.0	27.5	29.1	32.0
2001	27.3	21.6	20.5	23.7	28.0	31.1	34.5	33.6	33.0	28.2	30.2	28.5
<i>SAMOA</i>												
1995	8.4	7.5	5.9	12.0	—	—	18.1	19.7	—	17.7	12.7	13.1
1996	—	—	—	—	—	—	—	—	—	—	—	—
1997	—	—	—	8.2	15.3	23.7	16.5	15.7	14.5	11.8	11.1	10.6
1998	6.8	6.7	7.7	13.5	15.3	16.3	21.8	17.5	15.0	13.6	10.2	10.6
1999	9.1	7.3	7.3	—	17.6	13.9	16.9	—	16.2	15.1	13.8	8.2
2000	5.0	8.4	4.9	6.6	7.5	15.7	16.7	15.2	14.3	15.4	11.7	9.6
2001	7.8	8.3	5.9	9.3	17.6	13.3	15.2	18.9	19.1	16.8	15.5	10.9
<i>Summit, Greenland</i>												
2000	—	—	—	—	—	54.8	—	42.8	44.8	44.4	41.3	43.0
2001	42.1	42.2	45.1	45.7	49.9	49.3	42.8	46.2	41.9	46.6	41.9	41.6

—, no data.

*Data for 1998 and 1999 are revised.

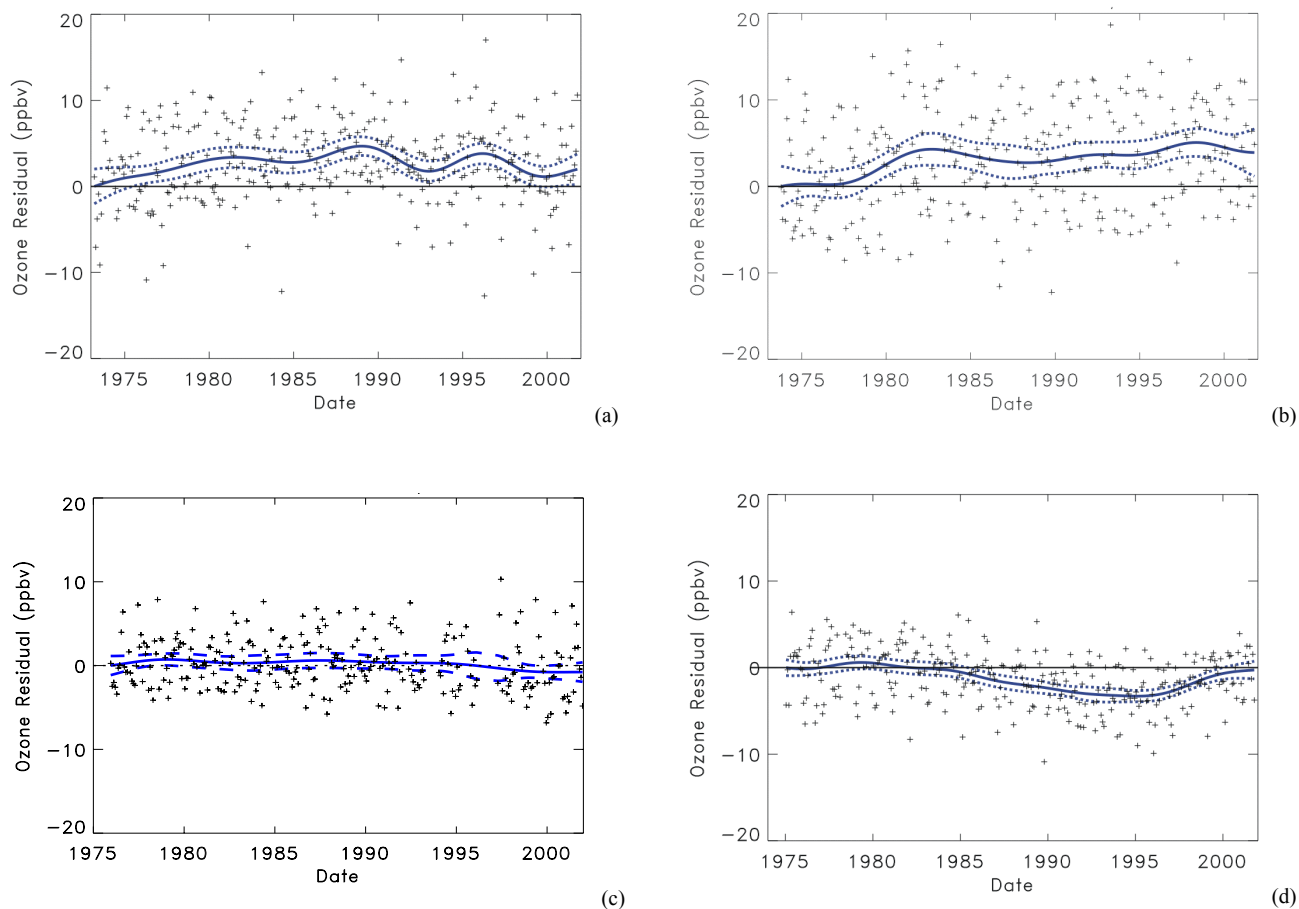


Fig. 4.4. Residual (+) and tendency curve (solid curve) of surface ozone mixing ratios at (a) BRW, (b) MLO, (c) SMO, and (d) SPO. The solid curve is a smooth fit to the filtered residuals. The dashed curves give the 95% confidence interval for the fit at each point.

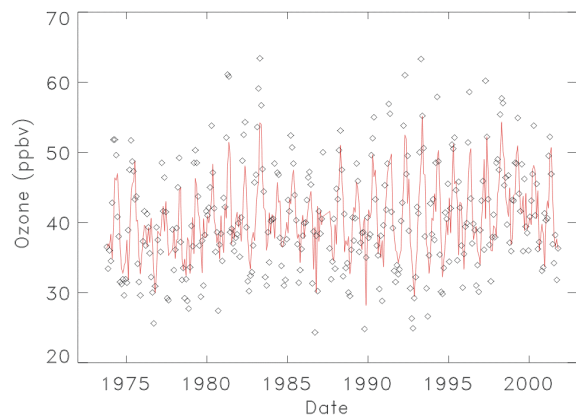


Fig. 4.5. Monthly mean surface ozone (\diamond) and the modeled result (solid line) for MLO.

TABLE 4.5. Average Growth Rate and Standard Error in Surface Ozone Mixing Ratio (ppbv yr^{-1}) at Four CMDL Sites

	BRW	MLO	SMO	SPO
Trend	0.07	0.15	-0.02	-0.01
Standard error*	0.04	0.06	0.04	0.03

*Determined by a Monte Carlo technique.